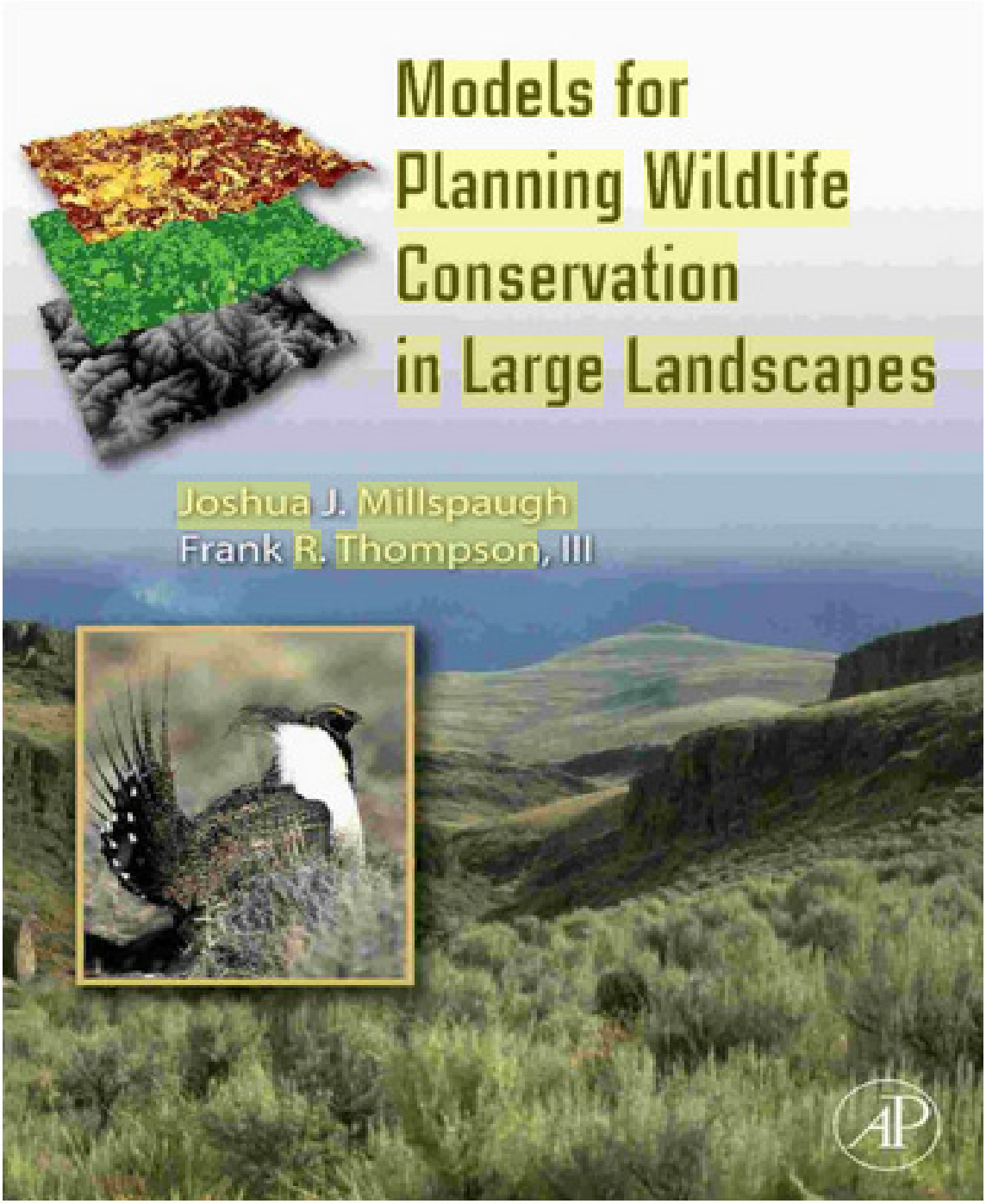
Models for
Planning Wildlife
Conservation
in Large Landscapes
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AP

CHAPTER 10 Wildlife Habitat-Relationships Models: Description and Evaluation of Existing Frameworks

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After identifying the major habitat-relationships modeling frameworks that fit the above four criteria, we rated each according to 10 nominal- and 5 ordinal-scale criteria to quantify our evaluation (Table 10-1). Nominal criteria included (1) whether the breadth of application of the framework could consider a wide range of species in a wide range of environments or was limited to certain taxa or a single environment; (2) whether the frameworks linked habitat conditions with population demographics or surrogates; (3) whether the frameworks were included in comprehensive landscape modeling systems; (4) availability of input data; (5) whether at least one individual species model based on a particular framework had been validated with field data; (6) capability of frameworks to examine habitat relationships at single or multiple scales; (7) whether multi-scaled frameworks required linkage information among scales to function; (8) whether the frameworks had attained scientific credibility through publication or application of results suggesting acceptance by an array of professionals; (9) the spatial application of the framework (i.e., does the framework use geographic data [spatial framework]?; does the framework examine spatial relationships in habitat data at specific locations or coordinates [spatially explicit]?; or, does the framework not rely on geographic or spatial data [aspatial])?; and (10) whether vegetation and its attributes were applied in the framework as the basis for a species-habitat matrix or as variables to assess habitat relationships for wildlife species (Table 10-1). Ordinal criteria included (1) whether documentation was adequate to clearly understand and apply the modeling frameworks; (2) ease of application; (3) whether output was well defined and measurable; (4) whether frameworks were well suited for the scales they were developed to examine; and (5) transparency of the frameworks' structure (Table 10-1). We conducted two independent reviews of each framework and then reached consensus on criteria ratings that differed.

Table 10-1 Nominal- and Ordinal-Scale Criteria Used to Rate Wildlife Habitat-Relationships Modeling Frameworks

Criteria	Definition	Rating Scale
Nominal criteria		
Breadth of application	Can the framework be used to define habitat relationships for a wide range of species in a wide range of environments?	0 = only suited for a single species or environment 1 = suited for a wide range of species in a wide range of environments
Habitat–population linkage	Does the modeling framework incorporate vital rates (e.g., production, survival), other demographic parameters (e.g., density, population size); surrogates (e.g., quality of home ranges, habitat conditions in critical reproductive habitats, presence/absence) of population demographic parameters; or does the modeling framework model habitat conditions without specific consideration of wildlife population parameters?	0 = does not rely on population demographics or surrogates of modeled species 1 = relies on surrogates for population demographic parameters or framework; can utilize population demographics if desired, but is not dependent on them 2 = specifically relies on population demographics of modeled species
Independence	Is the framework part of a larger landscape modeling system?	0 = a component of a larger landscape modeling system 1 = stands alone and is not part of a larger landscape modeling system
Input requirements	Is the required input data (e.g., GIS coverages, stand and wildlife inventory data) readily available in agency inventories?	0 = not readily available 1 = readily available
Model validation	Has output from at least 1 model developed within a framework been validated with field data?	0 = no validation known or validation impossible 1 = model validated
Scale application	Is the framework limited to 1 scale or can it explicitly examine differences in habitat conditions at a range of spatial scales?	1 = limited to 1 scale 2 = capable of examining habitat conditions at more than 1 scale (e.g., forest and region)
Scale linkage	If the framework is multiscaled, are the scales linked?	0 = scales are not linked 1 = scales are linked
Scientific credibility	Has the framework gained credibility through publication of results, application of results, or other mechanisms to suggest acceptance by an array of professionals?	0 = limited credibility 1 = at least 1 publication of results using this framework, or other application of the modeling framework

Table 10-1 Nominal- and Ordinal-Scale Criteria Used to Rate Wildlife Habitat-Relationships Modeling Frameworks *cont...*

Criteria	Definition	Rating Scale
Spatial application	Does the framework: not rely on geographic data (aspatial); examine geographic data (spatial framework); or examine spatial relationships in habitat data at specific locations or coordinates as part of its structure (spatially explicit)?	1 = aspatial 2 = spatial 3 = spatially explicit
Vegetation application	How does the framework apply vegetation and its attributes in modeling?	0 = applied as the basis for a wildlife species-habitat matrix 1 = applied as habitat variables to assess wildlife–habitat relationships
Ordinal criteria		
Documentation	Is there sufficient documentation (e.g., a user's manual or website) to clearly understand the modeling framework?	0 = limited 1 = marginal 2 = sufficient
Ease of application	Is the model difficult to parameterize, run, and understand the output?	1 = difficult 2 = moderate 3 = easy
Output definition	Is the output well defined and will it translate to something that can be measured?	1 = difficult 2 = moderate 3 = easy
Scale definition	Is the framework well suited for the scales it is defined to examine?	0 = not well suited 1 = moderately well suited 2 = very well suited
Transparency	Is the structure of the framework clear (i.e., is the flow of the framework apparent)?	1 = difficult 2 = moderate 3 = easy

FUTURE DIRECTIONS

A current trend in framework development is to incorporate spatially explicit procedures when evaluating wildlife-habitat relationships. We suggest all future frameworks for wildlife conservation in large landscapes be able to evaluate habitat conditions under explicit spatial contexts. Spatially explicit habitat modeling frameworks provide practitioners with the ability to evaluate habitat in relation to conditions in adjoining parcels, according to configurations of resources, and in relation to habitat features such as roads that may influence animal movements or other behaviors (McGarigal and Compton 2003).

Emerging frameworks that show promise for describing wildlife-habitat relationships and that may be considered by developers include Petri nets, which are mathematical tools that are useful for modeling concurrent, distributed, asynchronous behavior in a system (e.g., Gronewold and Sonnenschein 1998). Also, qualitative modeling (e.g., loop analysis [Justus 2006]) may be more practical as a framework than quantitative modeling because qualitative models require fewer resources and less modeling experience.

Developers of frameworks have consistently attained scientific credibility through published manuscripts describing the development or applications of models developed within their frameworks, but a major weakness for many frameworks continues to be a lack of validation (Raphael and Marcot 1986, Block et al. 1994, Roloff and Kernohan 1999). Model validation is critical so that models developed within any framework can be used with confidence (Shifley et al., this volume). Therefore, we recommend that models be validated through independent field study or by reserving some data used in model development. Of particular interest is the need to validate frameworks. Although some frameworks have been validated (e.g., BIRDHAB [Kilgo et al. 2002], CWHR [Block et al. 1994], EAM [Sisk et al. 1997], SHM (Karl et al. 2000]), validation has typically been applied to individual species models developed within the structure of frameworks. Both frameworks and models need validation; a framework may work well conceptually, while a specific habitat-relationships model developed within the framework may not. Although we focused on evaluating whether at least one species-specific model within a framework had been validated, we suggest that the need to validate frameworks is of even greater importance.

We suggest developers of future frameworks carefully consider the capability of practitioners to develop and apply models. Specifically, developers of new frameworks should consider using input data that are readily available in agency inventories, and develop frameworks with transparent structure and adequate documentation so that practitioners may clearly understand and apply the framework. We remind practitioners that if available data are poor quality or fail to adequately describe variables critical to the habitat requirements of a species, then only poor quality outputs will result. Thus, obtaining quality input data is paramount in modeling activities. A particularly important consideration for new frameworks is ensuring the availability of documentation, either online or printed user's manuals that clearly describe application of models developed within the framework, present examples of model applications, offer other resources such as descriptions of input and output data, document assumptions and functional forms (i.e., equations), and provide schematic descriptions of framework structures to enhance understanding of the model applications by practitioners.

As model frameworks become more sophisticated, users will increasingly face the issue of parameterizing complex models for species whose ecological relationships may not be well understood. For instance, the current understanding of spatial relationships and even basic habitat associations is poor for many vertebrates (e.g., U.S. Forest Service 2006). Therefore, it will be important to retain the ability within potentially complicated frameworks to develop simple models that reflect the level of ecological understanding for particular species.